



XRS 3000 Controller Reference Guide V-2

WHITE MAIN
POWER

POWER



SAFETY CIRCUIT
ENGAGED

SAFETY CIRCUIT



X-RAY
PREWARNING

PREWARN



X-RAY BEING
PRODUCED

X-RAY ON



CAUTION: X-RAYS PRODUCED WHEN ENERGIZED



THREE POSITION KEY SWITCH

1. OFF
2. STANDBY
3. ON

X-RAY ON
BUTTON

X-RAY OFF
BUTTON

DOCUMENT CONTROL PAGE
XRS 3000 CONTROLLER REFERENCE GUIDE

- | | |
|---------------------|-----------|
| 1. ORIGINAL RELEASE | 4-18-2015 |
| 2. REVISION ONE | 5-20.2015 |
| 3. REVISION TWO | 6-21-2015 |

Overview

The **XRS 3000** is specifically designed for controlling XRV series power supplies it will allow the user to control all necessary functions of the HVPS from touch screen window. Functional it is organized in to 3 screens that appear as tabs . The “**Status and Control**” screen will generally be the most frequently used. Additional screens for “**User Configuration**” and “**Options**” provide full functionality needed to completely control and monitor the XRV series power supplies.

Installation

System Requirements

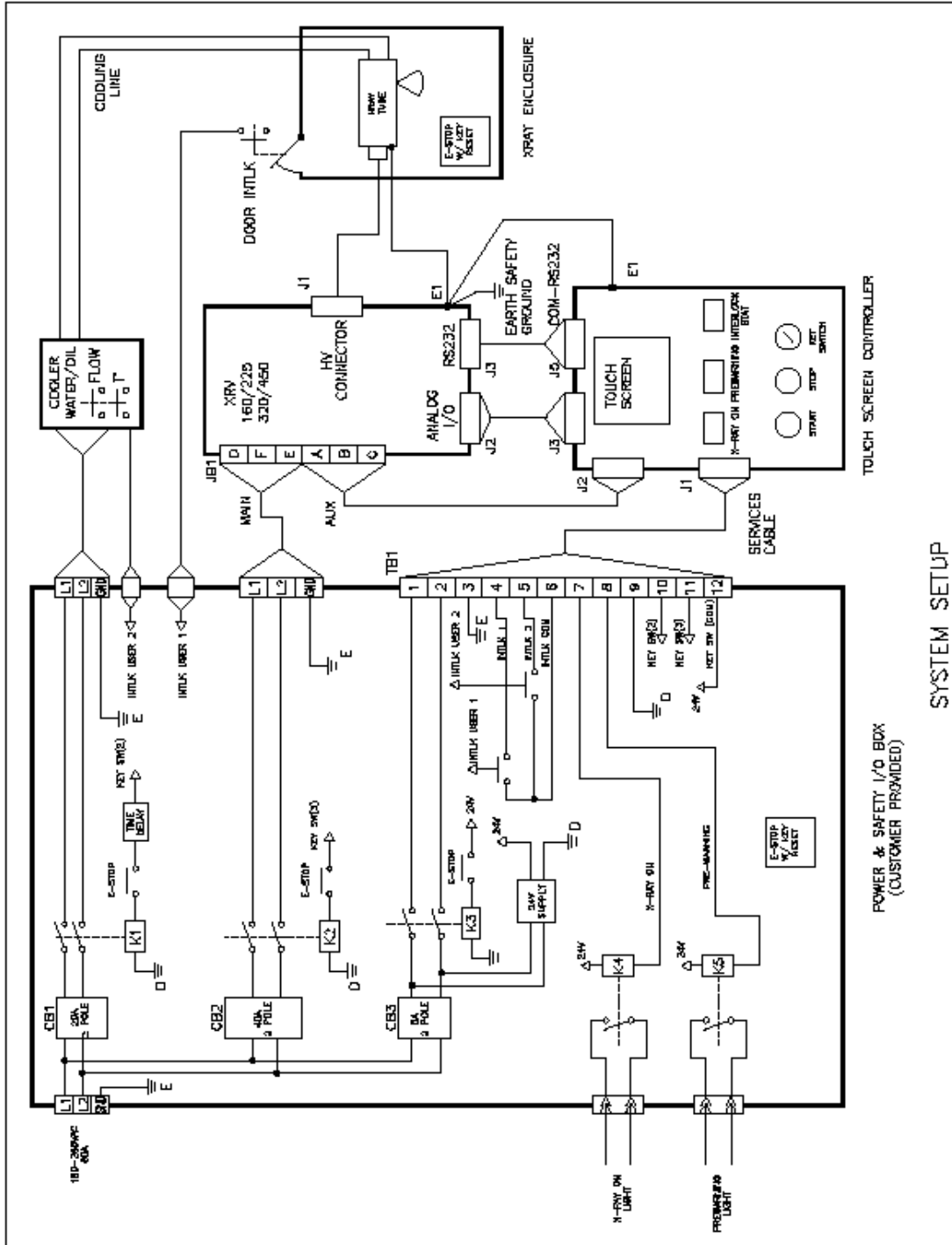
- XRV series HV Power Supply with rev C Control board or higher
- RS-232 Cable between XRV power supply and controller
- Analog I/O cable between XRV power supply and controller
- Control Cable (Service Cable) between XRV Controller and I/O Box
- Ground cable minimum 12 AWG between XRV power supply and controller

XRV Control board

- Control board rev C or higher with firmware >DSP SWM0195-005 and FPGA SWP0023-004 loaded, if required follow Spellman procedure 100960-551 upload procedure.
- XRV jumper settings

Jumper	Function	XRV 160	XRV 225	XRV320	XRV450
JP11	J2 I/O 24V Logic Level	Install 3-6	Install 3-6	Install 3-6	Install 3-6
JP12	Remote Control selection	Remove	Remove	Remove	Remove
JP24	J2:16 Clear Enable X-Ray	Install 2-3	Install 2-3	Install 2-3	Install 2-3

System Setup



Operation

Control Unit **XRS 3000**-CNTL overview

Front Panel



Key Switch: 3 position Safety Key switch inhibiting unauthorized operation

- Position 1-system is OFF and the key can be removed from switch housing
- Position 2-system is in STANDBY, cooler is enabled and aux power to HVPS is ON. No X-rays can be generated in this position (main contactor is OFF). Key can be removed from switch housing.
- Position 3-main contactor is ON providing power to the mains of HVPS, can enable X-rays. Key can't be removed from switch housing

Indicating Lights:

- **Power:** If lit the system has main power available.
- **Safety Interlock:** if lit GREEN all safety contacts are closed.
- **Pre warning:** If lit (YELLOW), indicating x-rays are imminent within time set by user (adjustable prewarning 1-30 sec via touch screen))
- **X-ray On:** If the X-RAY ON LIGHT (RED) , X-rays are ON

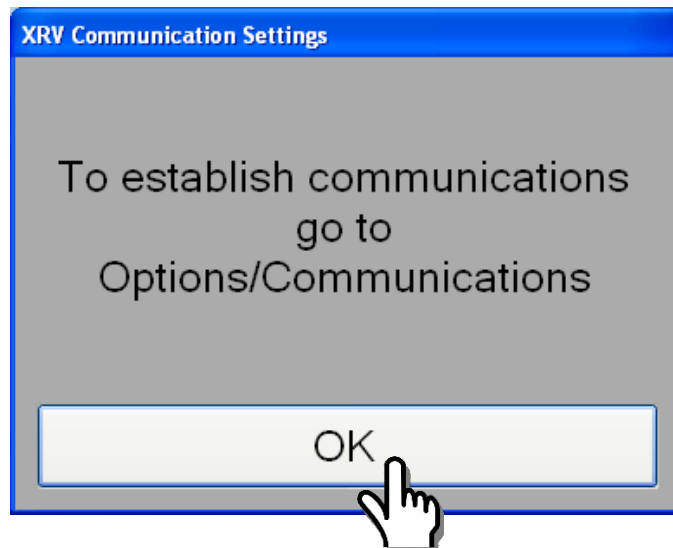
X-Ray ON Switch

- X-Ray ON push button switch (Green), X-rays will be produced if filament is ON

X-Ray OFF Switch

- X-Ray OFF push button switch (Red)

Communications.



Press "Setup Communications"

Status and Control | User Config | Options

Setup Communications

System Voltages

Filament Status

About

Close Application

HV Hours On Timer

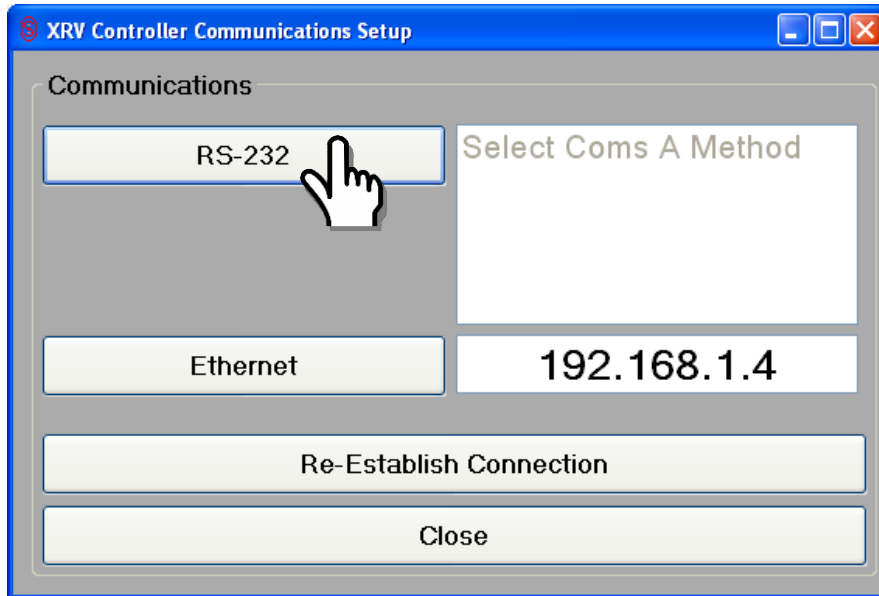
Do not show intro video

Coms: Not Active | Intlk Stat: Open | HV Inverter: Not Ready | Fault: No Coms

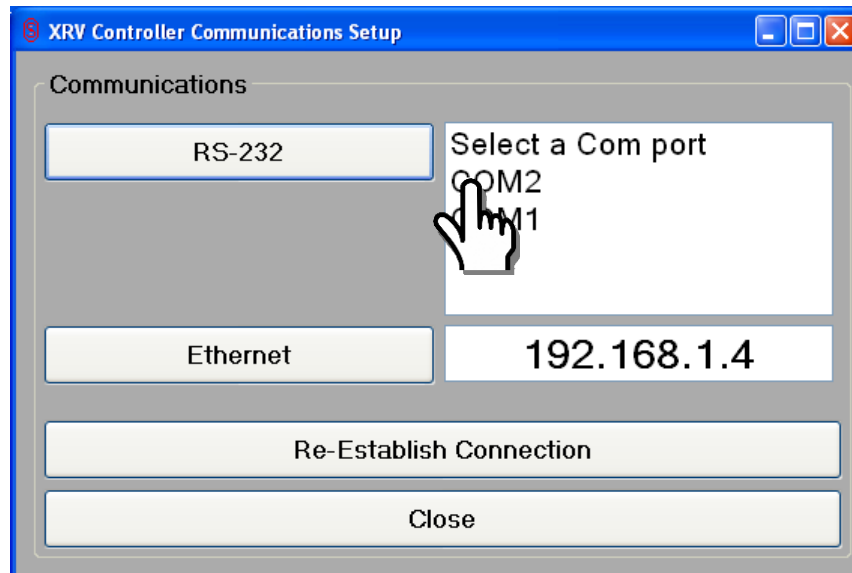
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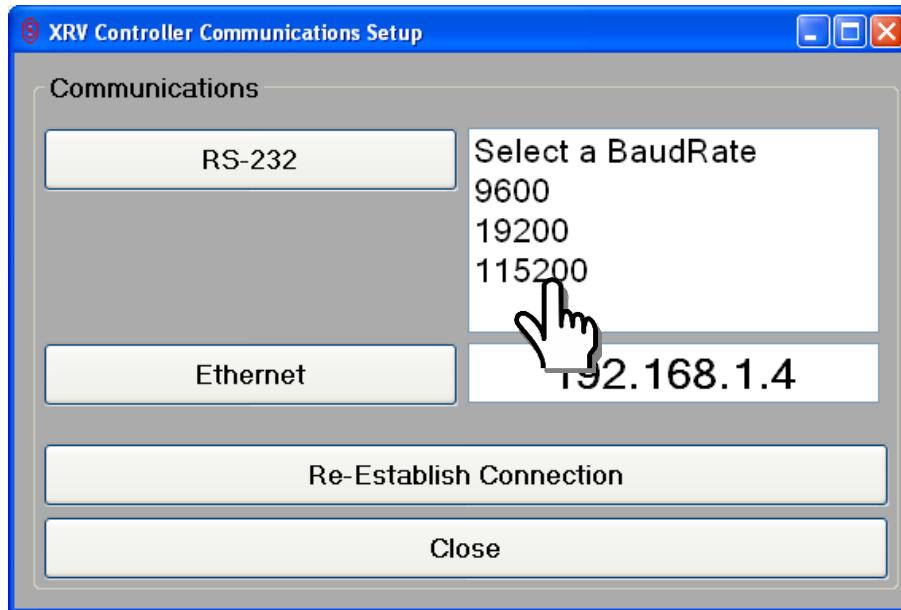
Select RS-232



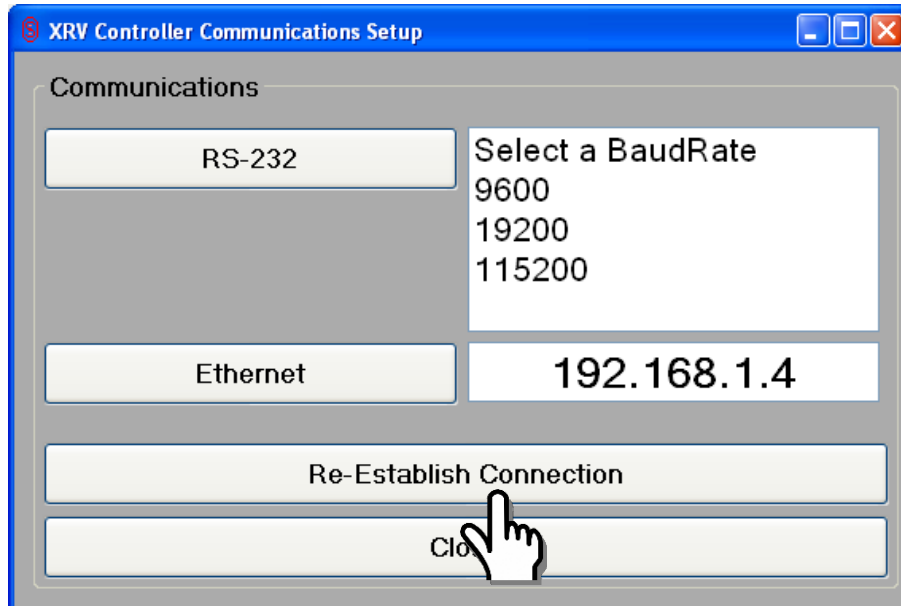
Select COM Port 2



Select baud rate 115200

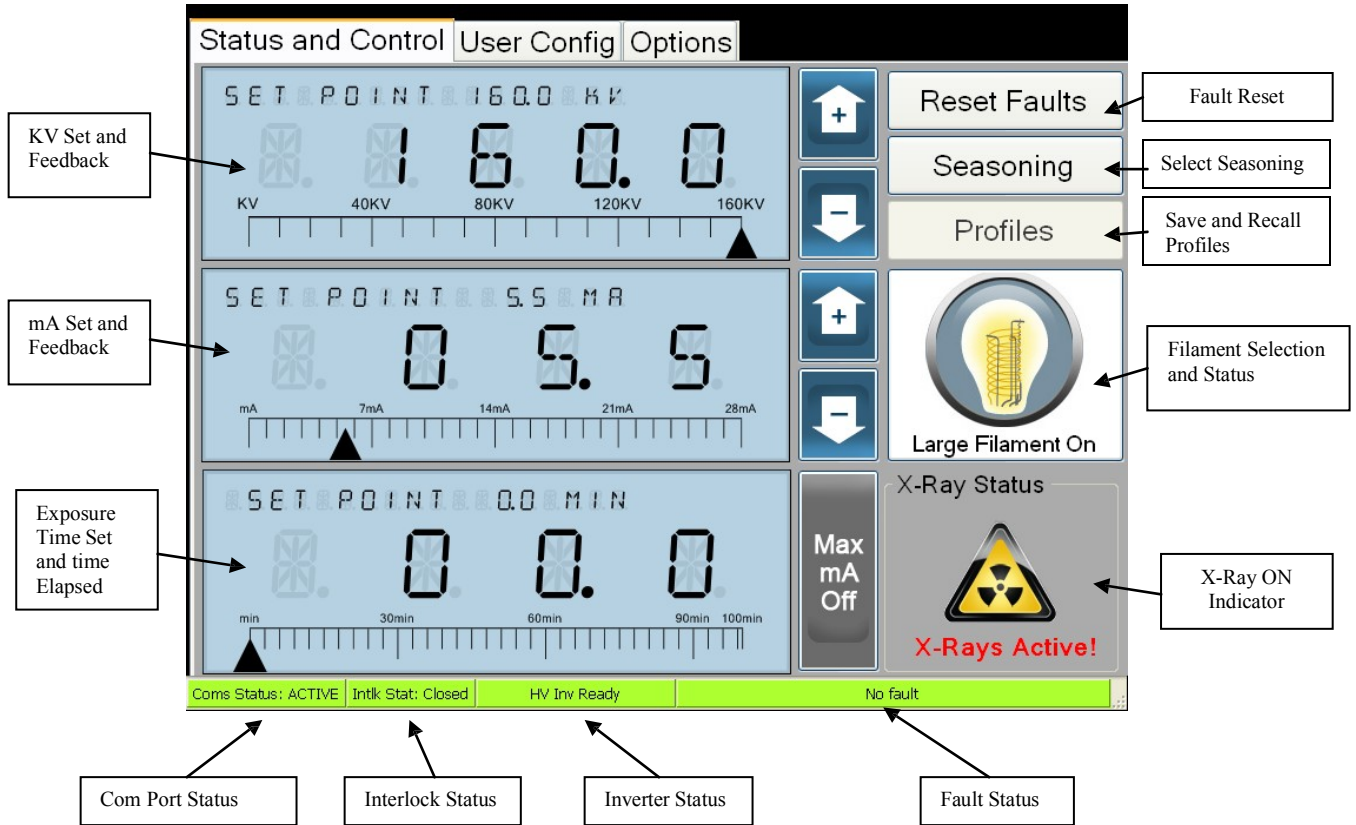


Re-Establish Communication and press “Close” to save.



Touch Screen

Status and Control Screen



Status Indicators

Coms Status: Indicates communication is “ACTIVE” with XRV unit

Coms Status: ACTIVE

Interlock Status: Indicates if interlocks are open or closed.

Intlk Stat: Closed

Intlk Stat: Int Intlk Open

- Internal Interlock: internal interlock is open HV will be inhibited.
- Interlock 1: interlock 1(external) is open HV will be inhibited.
- Interlock 2: interlock 2(external) is open HV will be inhibited.

HV Inverter Status: Indicates if HV Inverter is ready or not ready if in **RED**, if main ac line is not applied or inverter has internal fault.

HV Inv Ready

HV Inv Not Ready

Fault Status: indicates power supply fault has occurred, if **RED**.

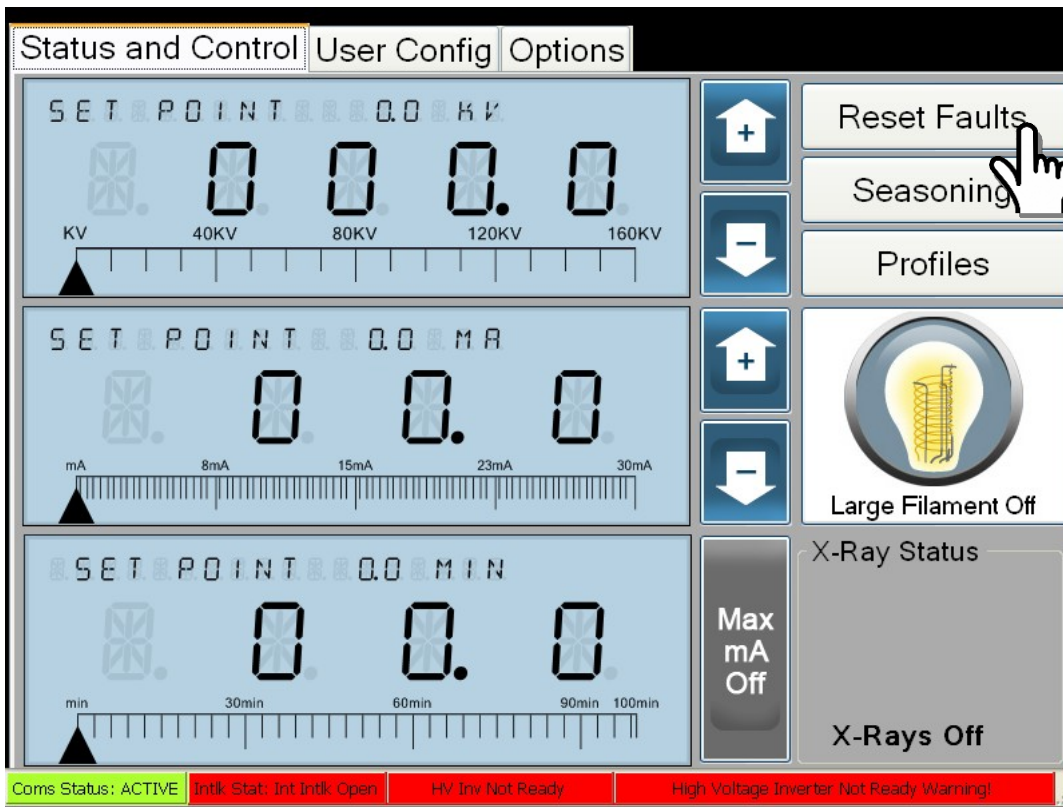
No fault

High Voltage Inverter Not Ready Warning!

- Fil selection Fault: indicates failure in the section of the large or small filament.
- LVPS -15V Fault: indicates -15V DC on system control board has failed.
- LVPS =15V Fault: If lit, +15V DC on system control board has failed.
- Watch Dog Fault: indicates unit has lost communication between HVPS and computer.
- Cathode, Anode: power inverter status information, if unit is bipolar anode indicators will be relevant.
 - Temp: indicates inverter temperature fault.
 - OC: If lit, indicates inverter over current fault.
 - Cable connect: If lit, indicates internal cable connection fault.
 - DC Rail Monitor: indicates inverter DC Rail Fault. This may be lit if Main AC Power is interrupted by safety interlock during normal operation.
 - AC Line Monitor: indicates inverter Main AC Power Fault. This may also indicate if Main AC Power is interrupted by safety interlock during normal operation.
- OV Fault: indicates Over Voltage Fault, output voltage is 10% above request value or 5% above unit rated voltage.

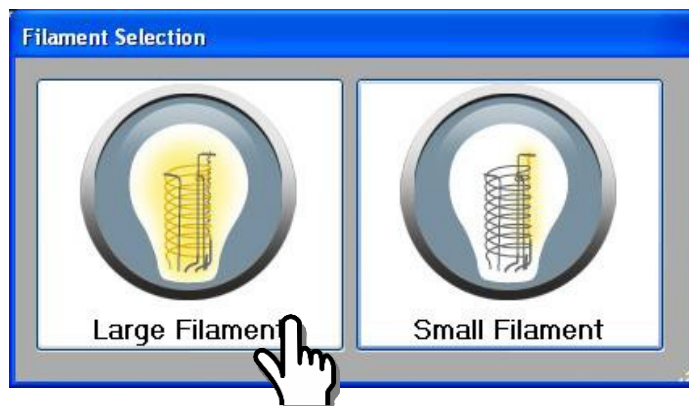
- UV Fault: indicates Under Voltage Fault, output voltage is 10% below request value.
- OC Fault: If lit, indicates Over Current Fault, output current is 10% above request value.
- UC Fault: If lit, indicates Under Current Fault, output current is 10% below request value.
- HV Inverter Fault: indicates Inverter Fault.
- Over Temp Fault: indicates over temperatures fault, unit detected temperatures that exceed 50 deg C ambient.
- mA diff Fault: indicates mA difference fault, valid for bipolar units, current on anode side is not equal to the cathode side
- KV diff Fault: indicates voltage difference fault, valid for bipolar units, voltage on anode side is not equal to the cathode side.
- ARC Cathode: indicates Arc Cathode, unit detected an arc on the cathode; a fault will occur if number arcs detected exceeded arc counter setting (see user config).
- ARC Anode: indicates Arc Anode, unit detected an arc on the anode; a fault will occur if number arcs detected exceeded arc counter setting (see user config).
- Temp Approach Warning: indicates ambient temperature is above 45 deg C

Reset Fault: Pressing “Reset Faults” will clear faults, its recommend that faults should be viewed before clearing faults.



Filament Selection and Status: Status indicates filament is ON or OFF and if large or small is selected. Touch screen for filament selection:

Filament Selection: Touch the Large or Small Filament Selection for filament selection.



Filament status: indicates which filament is selected and if it's on or off.

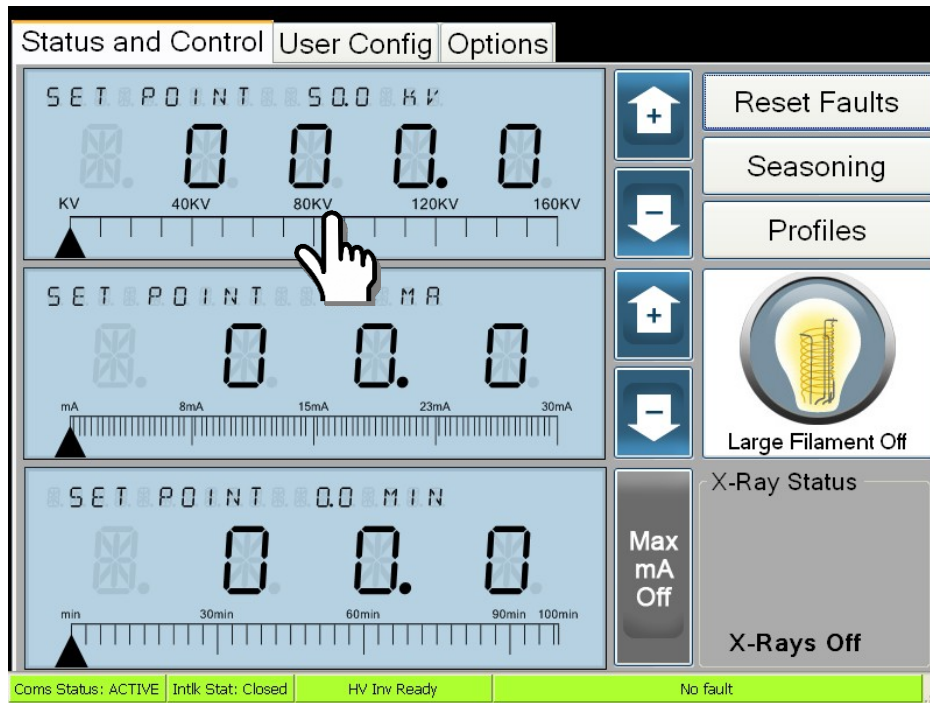


X-Ray ON Indicator: If "X-Ray Active" is displayed unit is producing X-Rays.

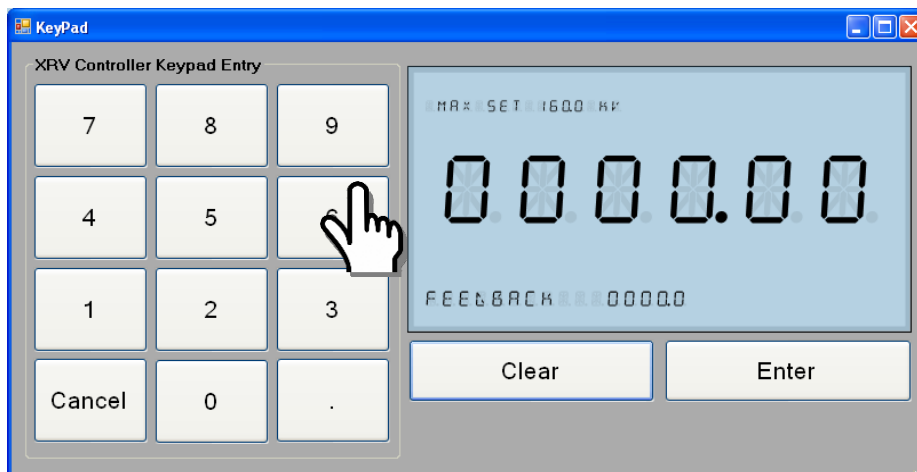


Control and Displays

kV Setting box: Touching the kV numeric box will display keypad which is used for entering exact values.

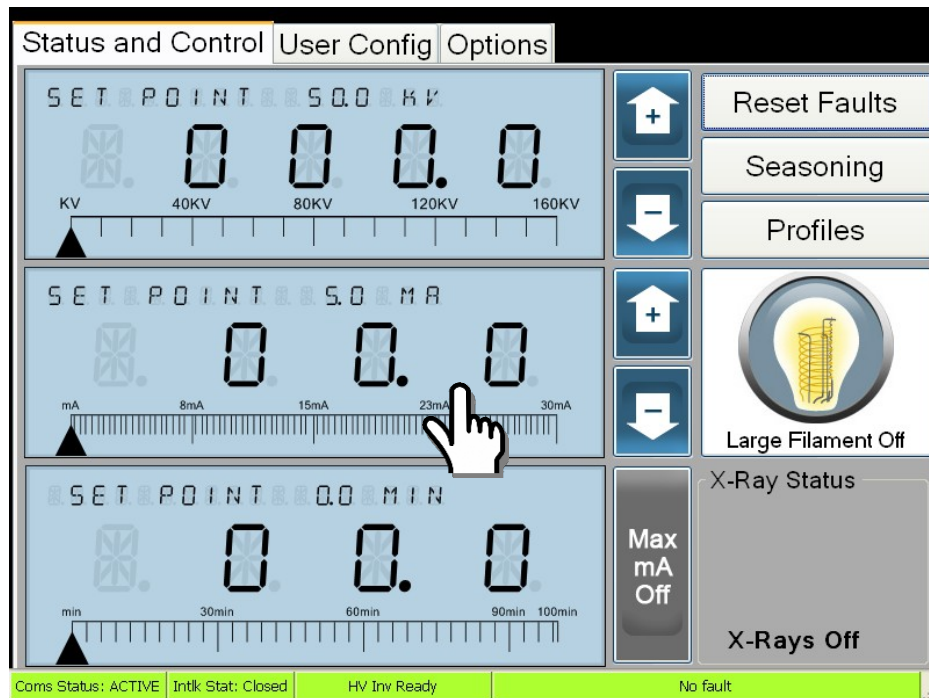


Enter value with keypad and press “Enter” to validate value.

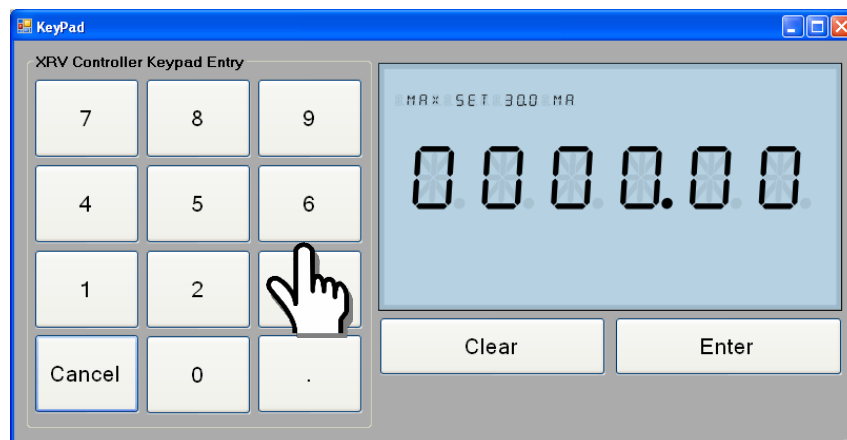




Fine adjustment can be made with the  or  arrow key after value has been entered. Turning the X-ray ON will display actual high voltage.

mA Setting: Touching the mA numeric box will display keypad which is used for setting exact value.

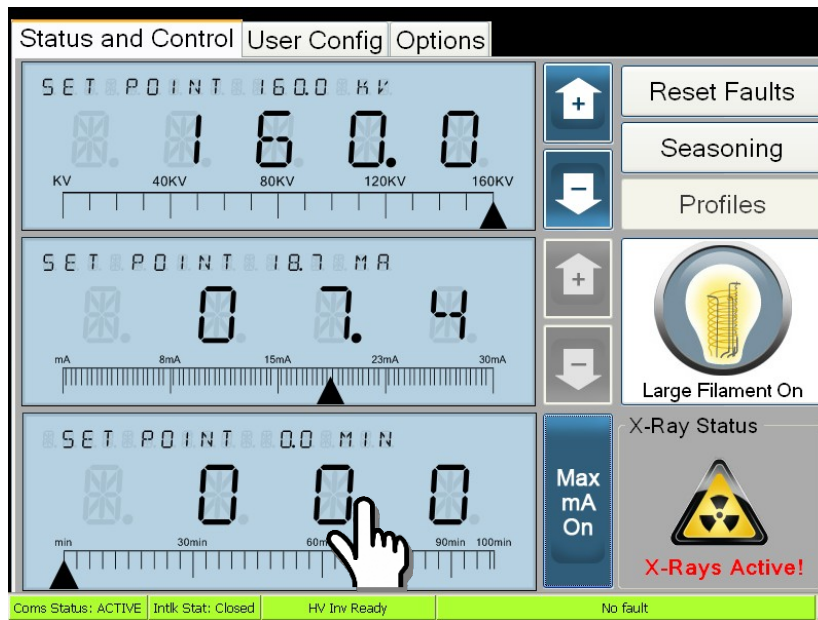


Enter value with keypad and press “Enter” to validate value.

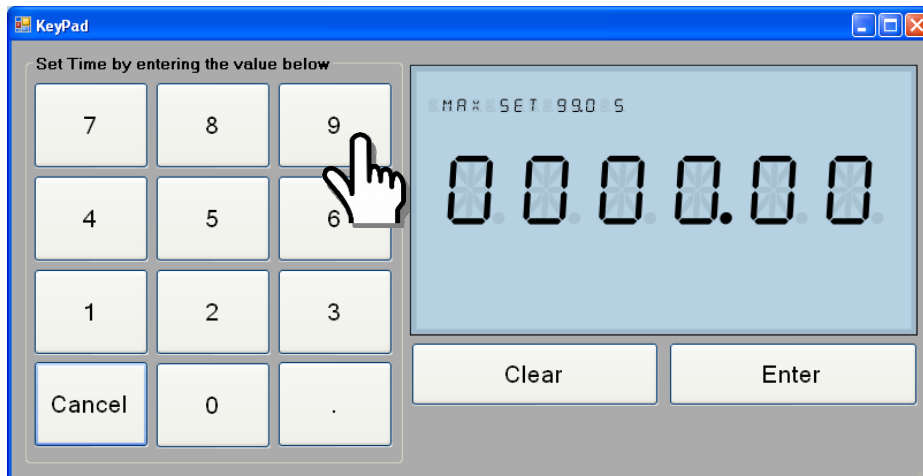


Fine adjustment can be made with the  or  arrow key after value has been entered. Turning the X-ray on will display actual current.

Exposure Time Setting: Touching the Exposure Time numeric box will display keypad which can be used for setting exact values.



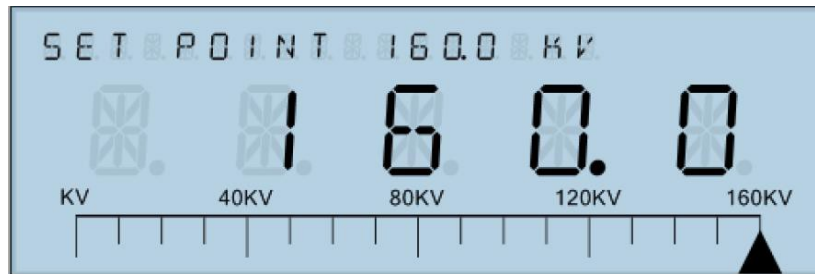
Enter value with keypad and press “Enter” to validate value.



Turning the X-ray on will display time remaining in the exposure.

Note: the Exposure Time setting is activated if >00.0 is entered. If “00.0” is entered the unit is in “Fluoroscopic” mode or the exposure timer is disabled and when X-Ray switch is ON, X-rays will remain ON until manually terminated with X-Ray push button OFF or PS Fault has occurred.

KV Feedback: numeric box indicating actual voltage.

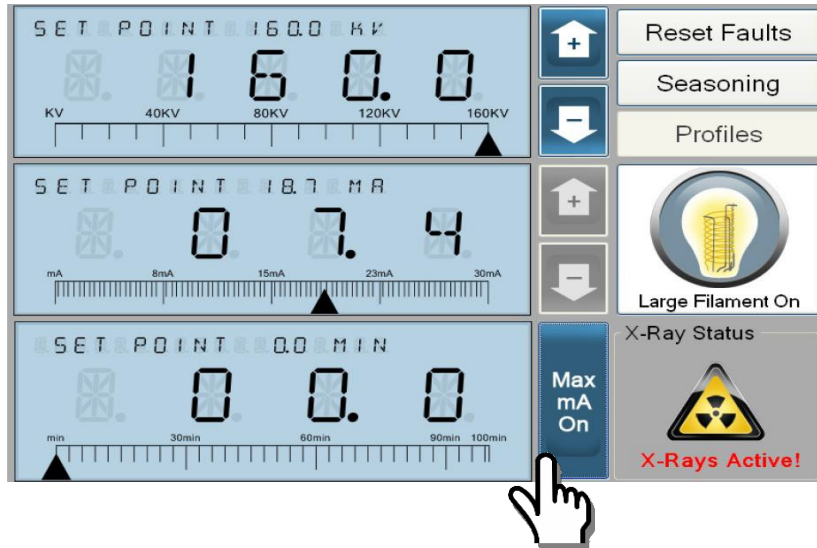


Current Feedback: numeric box indicating actual current.

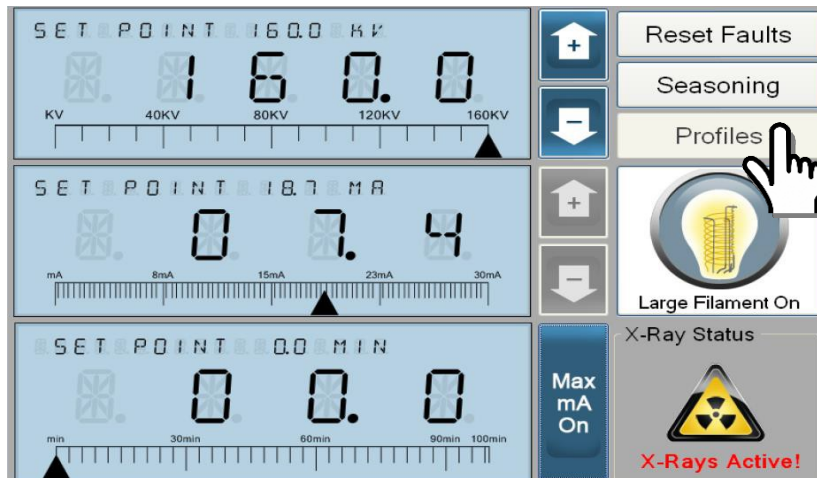




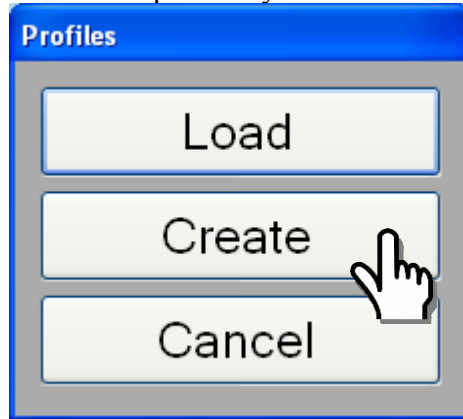
Max mA: if **Max mA On** is ON max mA is selected, requested mA current will be determined by $(\text{Power Limit Large or Small Filament}) / (\text{KV set})$ and is limited to Max current as defined in the User Configs for the parameter “Max mA and mA set point will be disabled.



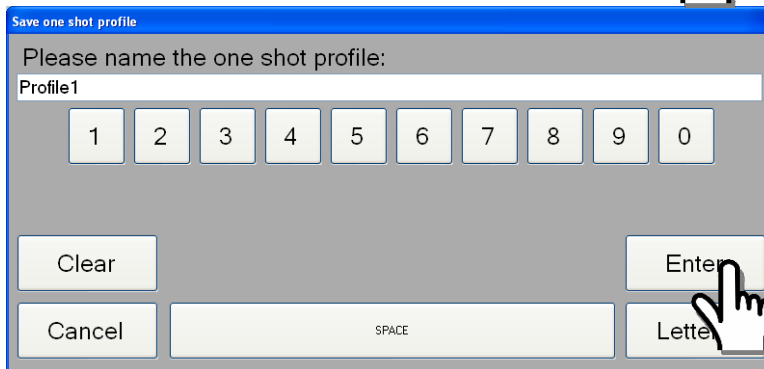
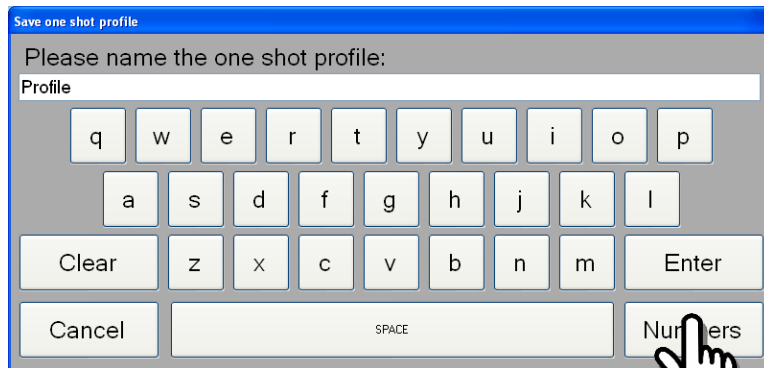
Profiles: save and recall recurring exposure data by name.



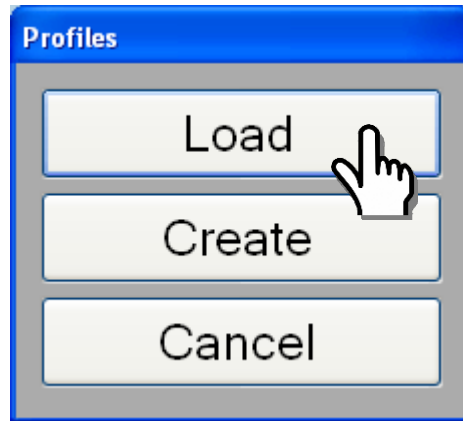
Create one shot profile: Set the desired kV, mA and exposure time and then press “Create” to save one shot profile by name. Press “Enter” to save.



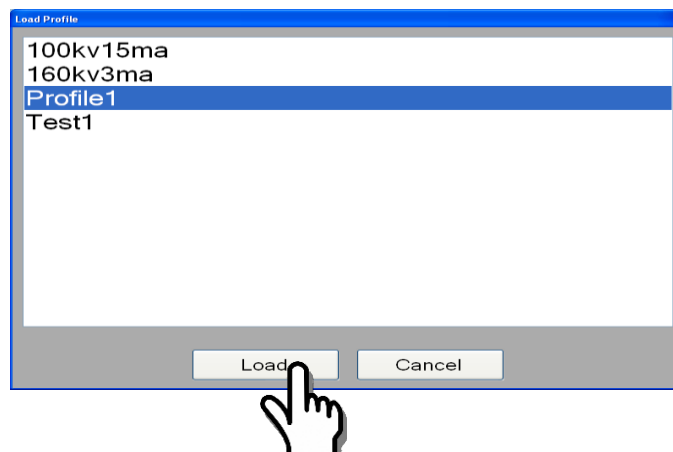
Enter profile name and press enter to save.



Load One shot Profile: press “Load” and then select name and press “Load” again in the Load Profile window.



Select name and press load



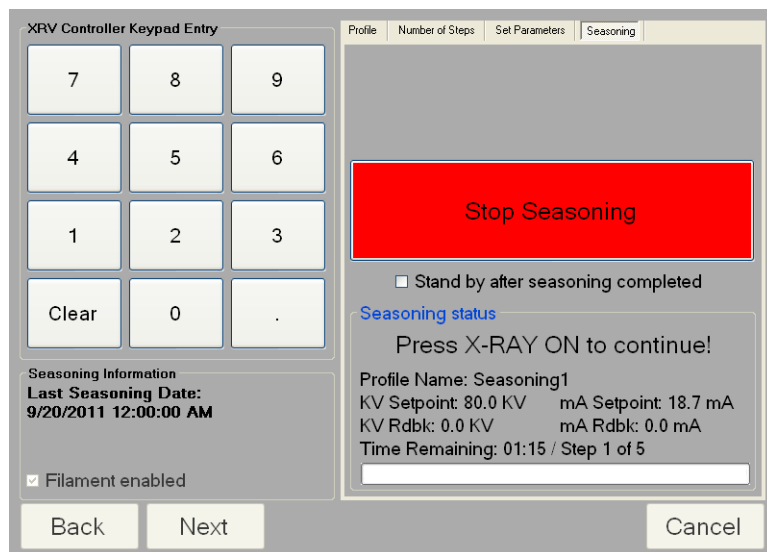
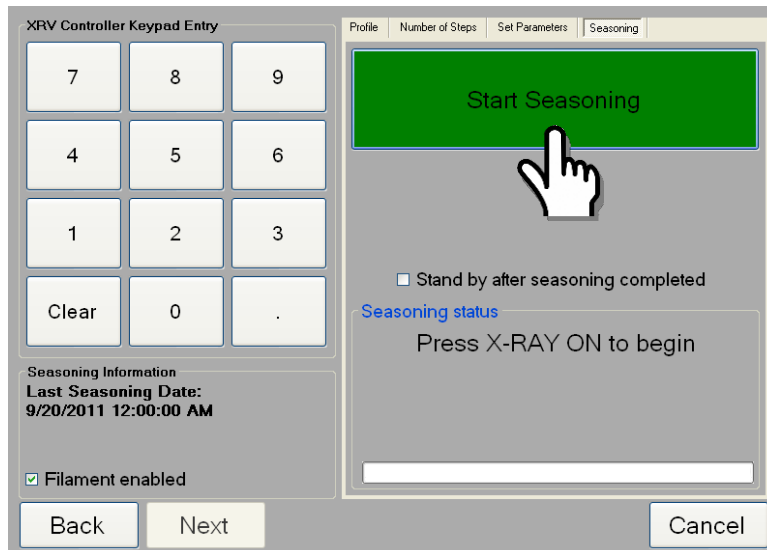
Tube Seasoning

Automating Seasoning: interval of the X-Ray tube seasoning is established by built-in real time clock, with time span determined by the last time tube was seasoned, 4 possible profiles, 3 profiles Day, Week and Monthly which are automatically selected. These profiles are based on the last time the tube seasoning has been done. The 4th profile is user defined; seasoning parameters for kV set point, mA set point and time interval must be initial manually entered, with infinite number of steps in the seasoning profile.

Press “Yes” to enter seasoning menu.



Start Seasoning: Press “Start Seasoning” profile. Prior the start of the seasoning filament will automatically turn ON before seasoning will start.

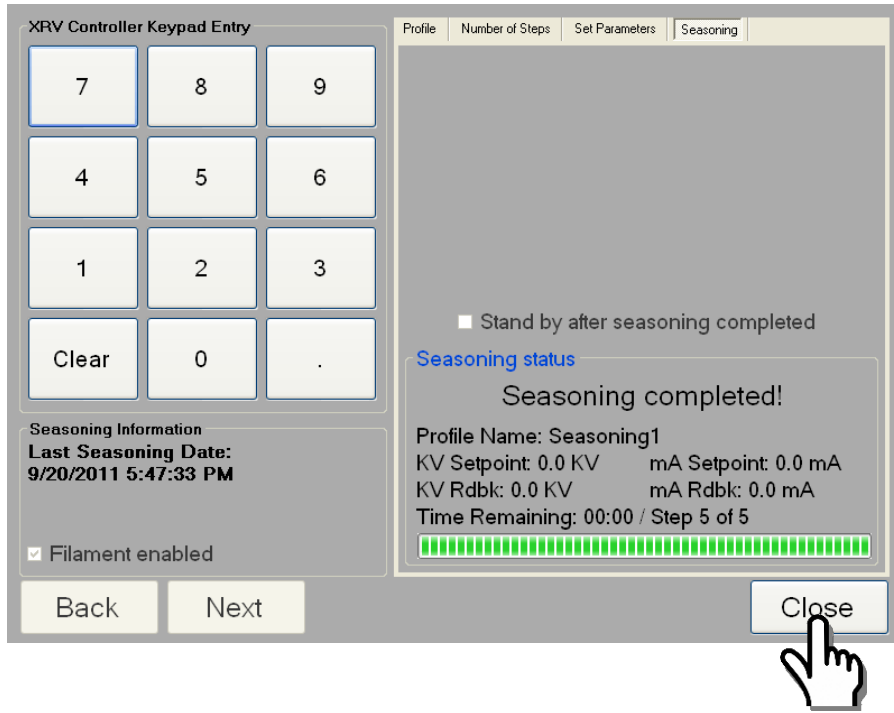


Press X-RAY ON push button to turn on X-ray's and seasoning will start.

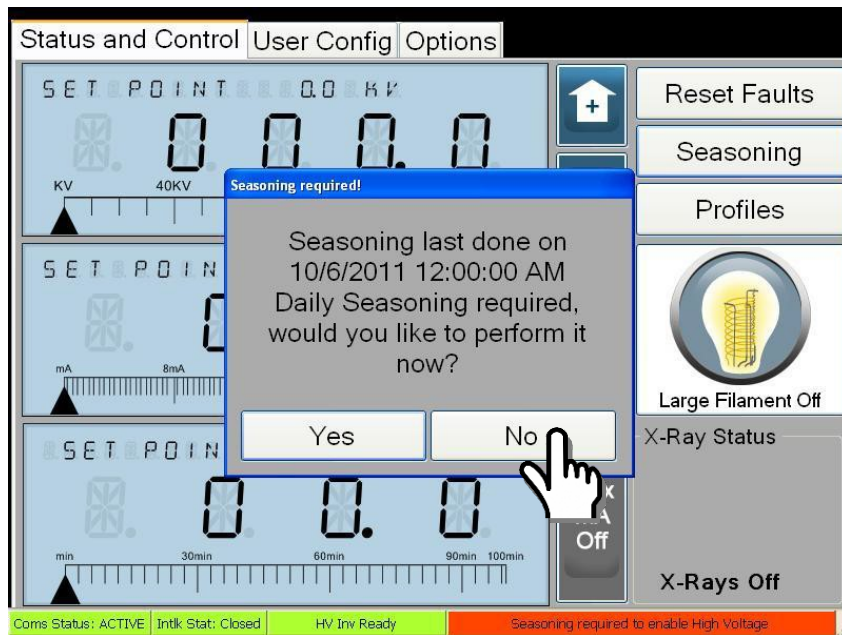
Seasoning in progress

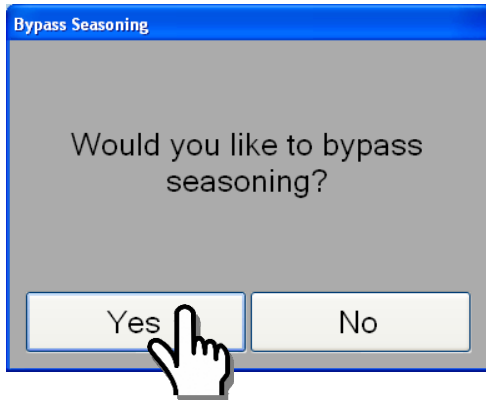
The screenshot shows the 'XRV Controller Keypad Entry' interface. On the left is a keypad with buttons for digits 0-9, a 'Clear' button, and a decimal point. Below the keypad is 'Seasoning Information' showing the last seasoning date as 9/20/2011 12:00:00 AM and a checked 'Filament enabled' option. At the bottom are 'Back', 'Next', and 'Cancel' buttons. The main display area has tabs for 'Profile', 'Number of Steps', 'Set Parameters', and 'Seasoning'. A large red 'Stop Seasoning' button is prominent. Below it is a checkbox for 'Stand by after seasoning completed'. The 'Seasoning status' section shows 'Seasoning in progress! (29%)' and provides technical details: Profile Name: Seasoning1, KV Setpoint: 120.0 KV, mA Setpoint: 18.7 mA, KV Rdbk: 119.9 KV, mA Rdbk: 18.6 mA, and Time Remaining: 00:53 / Step 2 of 5. A progress bar with 10 green segments is at the bottom of the status section.

Seasoning completed: Touch “Close” exit to main manu.



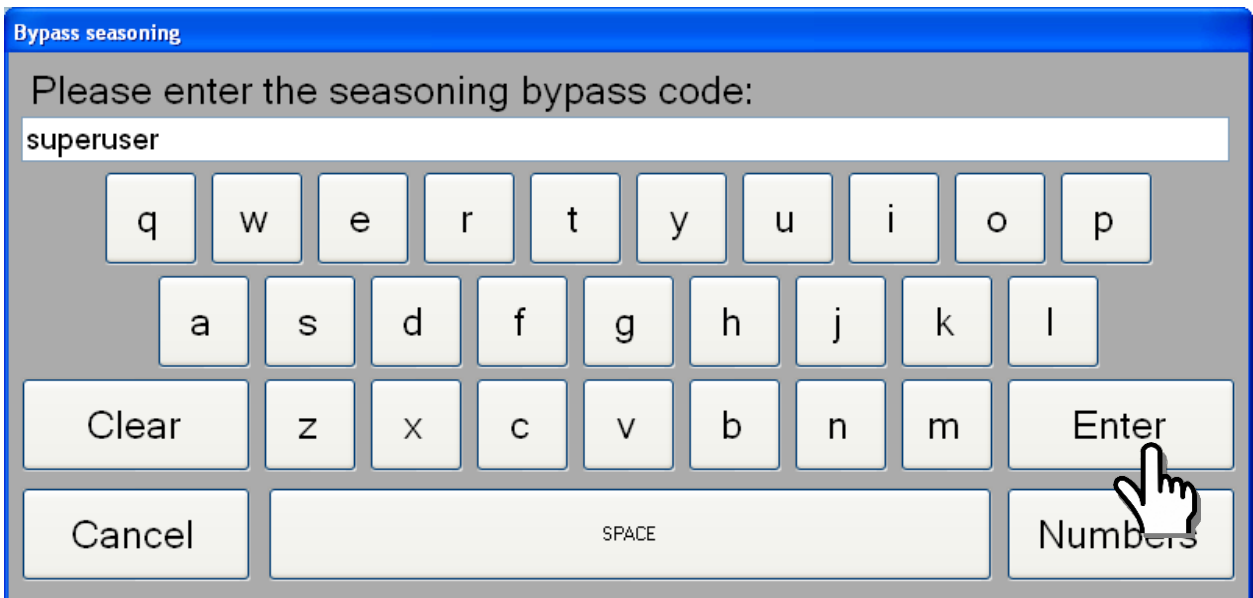
Bypassing Seasoning: Pressing “NO” for seasoning will put the user into “Bypass Seasoning” mode, which will prompt the user to enter a password.





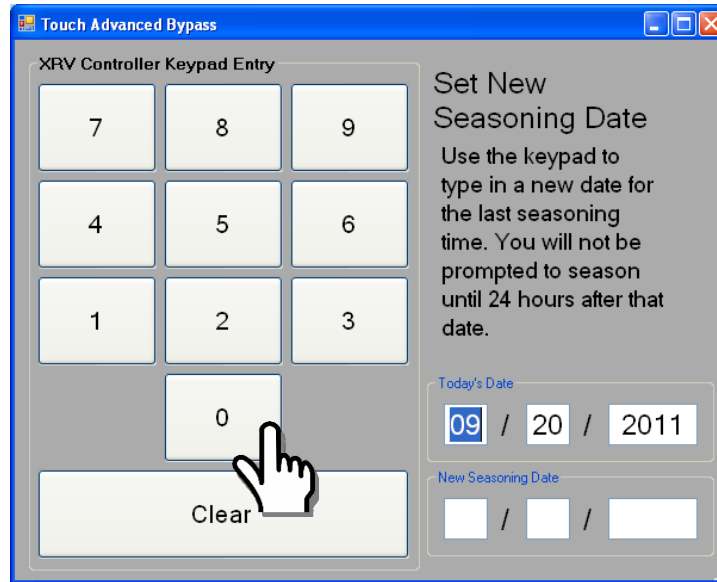
Only persons who are properly trained are allowed access.

Entering this password after clicking bypass password will bypass the required seasoning or skip the seasoning process. This will allow the user to operate the unit to the entered bypassed date below, and then the user will be prompted to perform seasoning again after the date expires.

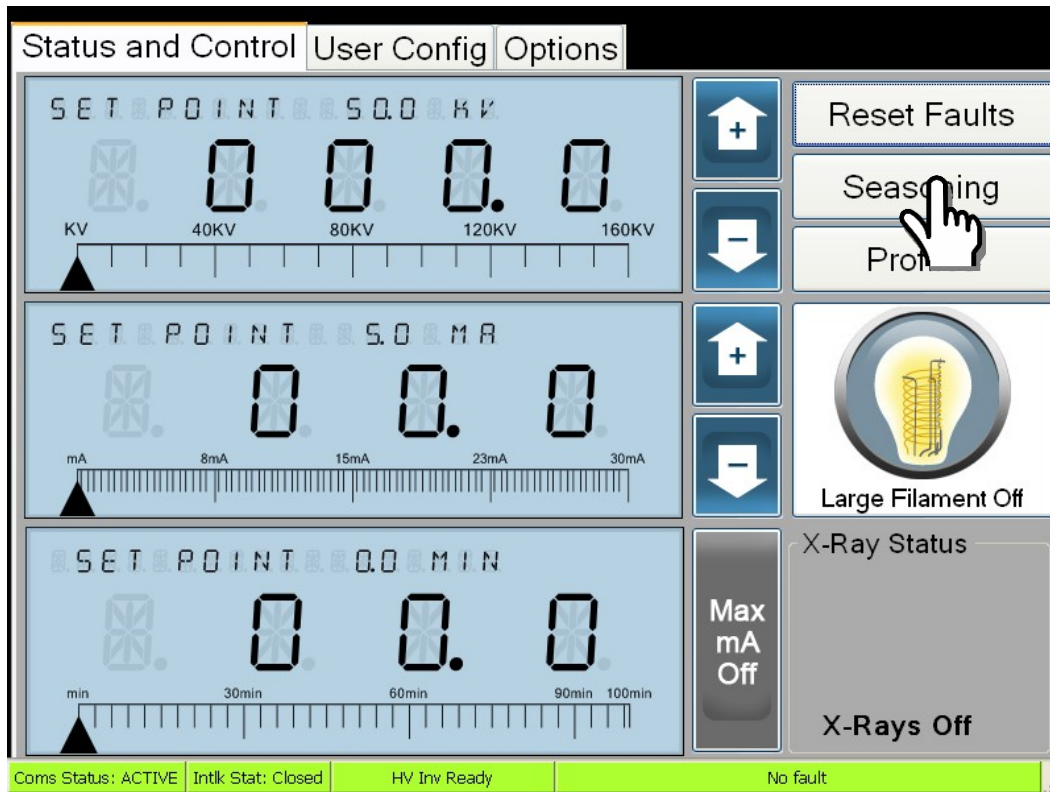


Entering this password will allow the user to modify the last date in which seasoning was performed.

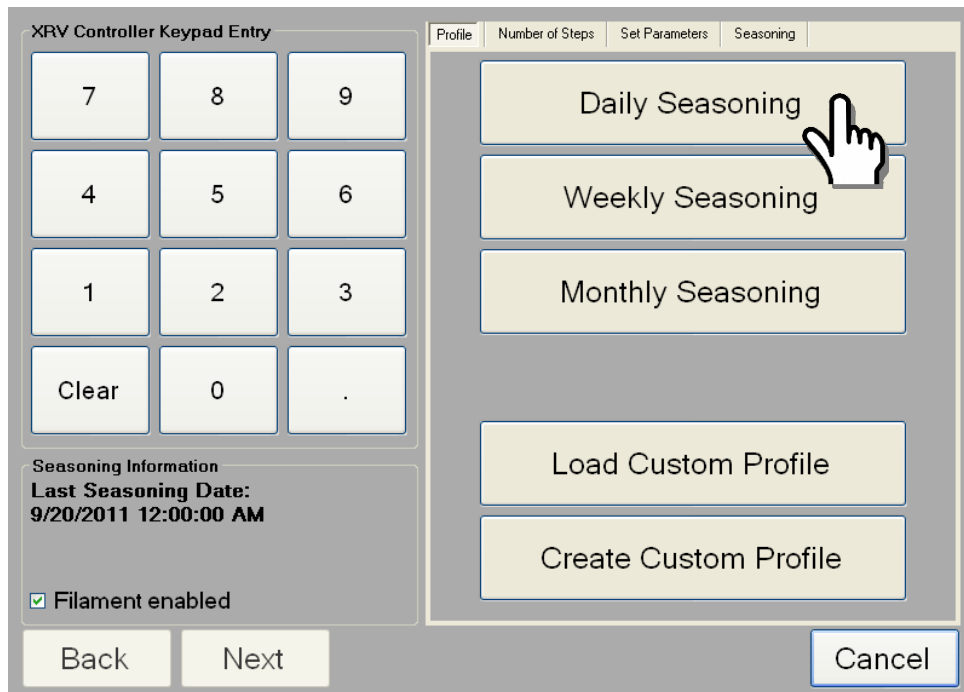
Enter new seasoning date



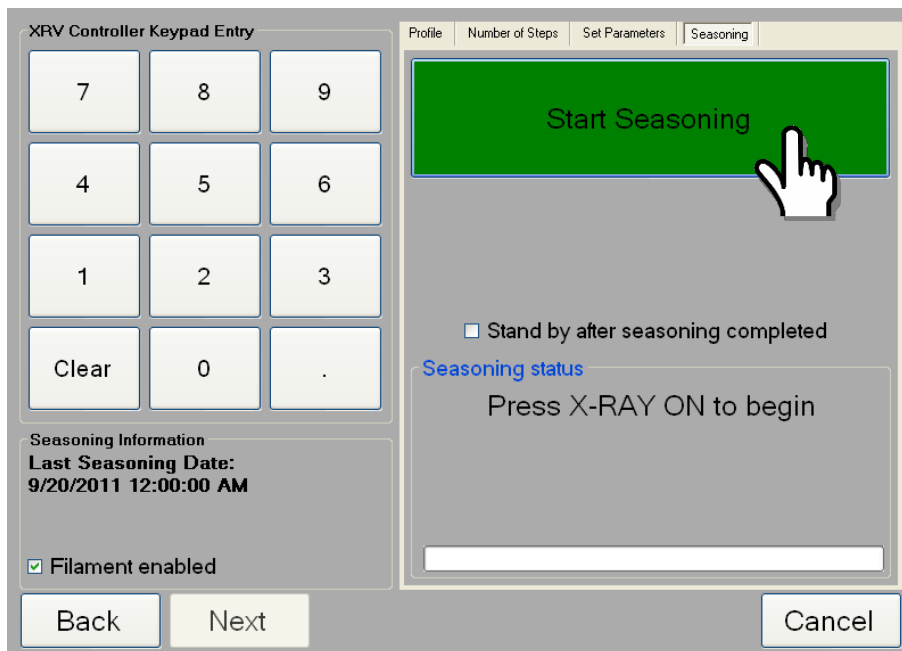
Manual Seasoning: To force seasoning press “Seasoning” it will put the user into seasoning mode.

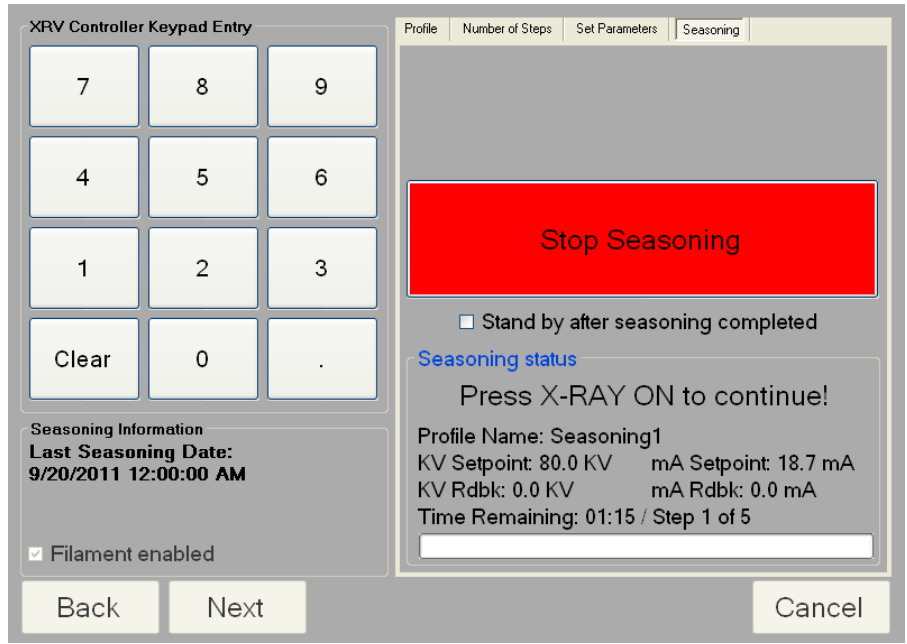


Select seasoning profile to enter into seasoning mode



Press “Start Seasoning”

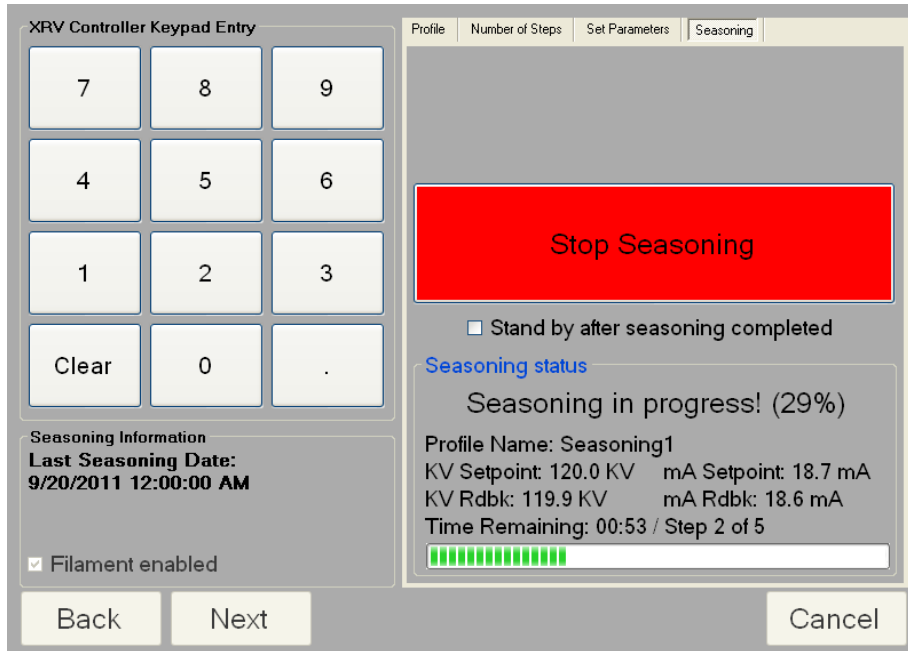




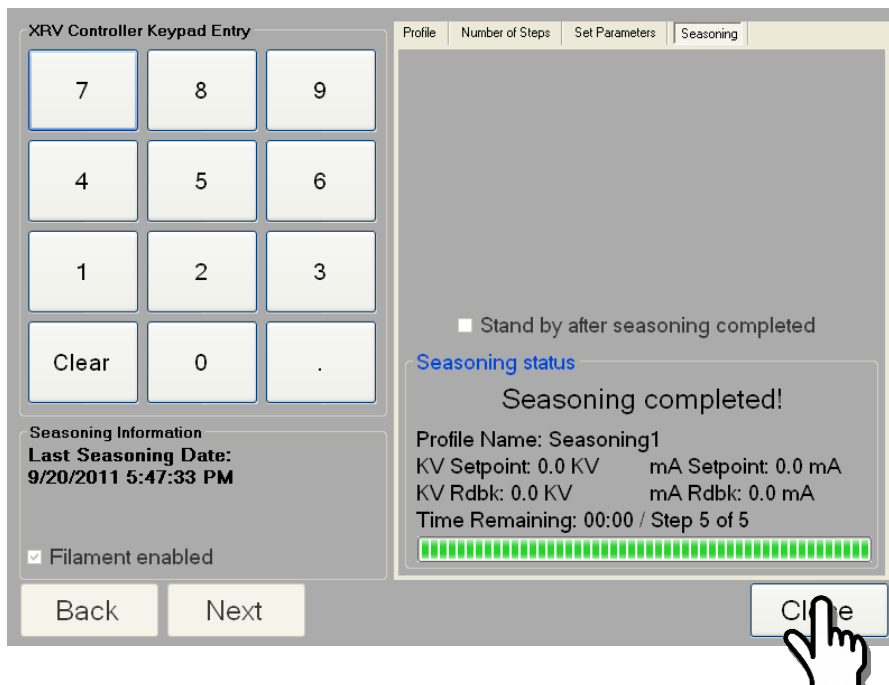
Press X-Ray ON push button to start seasoning



Seasoning in progress



Press "Close" to exit seasoning



Creating Custom Seasoning Profile:

Press Custom Profile

The screenshot shows the 'XRV Controller Keypad Entry' interface. On the left is a numeric keypad with buttons for digits 0-9, a 'Clear' button, and a decimal point. Below the keypad is 'Seasoning Information' showing 'Last Seasoning Date: 9/20/2011 12:00:00 AM' and a checked 'Filament enabled' option. At the bottom are 'Back' and 'Next' buttons. On the right, the 'Seasoning' tab is active, displaying buttons for 'Daily Seasoning', 'Weekly Seasoning', 'Monthly Seasoning', 'Load Custom Profile', and 'Create Custom Profile'. A hand cursor is pointing at the 'Create Custom Profile' button. At the bottom right is a 'Cancel' button.

Select number of steps

The screenshot shows the 'XRV Controller Keypad Entry' interface with the 'Number of Steps' tab selected. The keypad and 'Seasoning Information' are visible on the left. The main area displays the text 'Select number of seasoning steps' with a hand cursor pointing to it. Below this is the instruction: 'Please use the keypad or up and down buttons below to select the number of seasoning steps to perform.' Underneath, it says 'Number of Seasoning Steps:' followed by a display showing the number '5'. Below the display are 'Up' and 'Down' buttons. At the bottom are 'Back', 'Next', and 'Cancel' buttons.

Select mA, kV, and time

XRV Controller Keypad Entry

7	8	9
4	5	6
1	2	3
Clear	0	.

Seasoning Information
Last Seasoning Date:
9/20/2011 12:00:00 AM

Filament enabled

Back Next Cancel

Profile Number of Steps **Set Parameters** Seasoning

Set seasoning parameters

Please type in an mA value for step 1 using the on-screen keypad.

	kV	mA	Time (min)
▶	88.0	0	0
	0	0	0
	0	0	0
	0	0	0
	0	0	0
	0	0	0
	0	0	0
	0	0	0
	0	0	0
	0	0	0
	0	0	0

XRV Controller Keypad Entry

7	8	9
4	5	6
1	2	3
Clear	0	.

Seasoning Information
Last Seasoning Date:
9/20/2011 12:00:00 AM

Filament enabled

Back Next Cancel

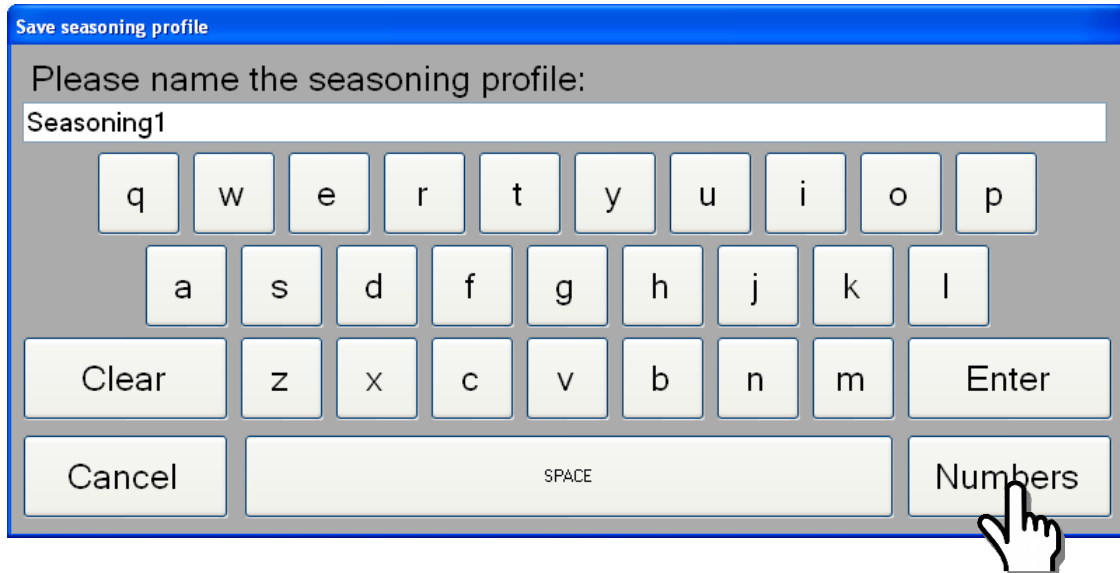
Profile Number of Steps **Set Parameters** Seasoning

Set seasoning parameters

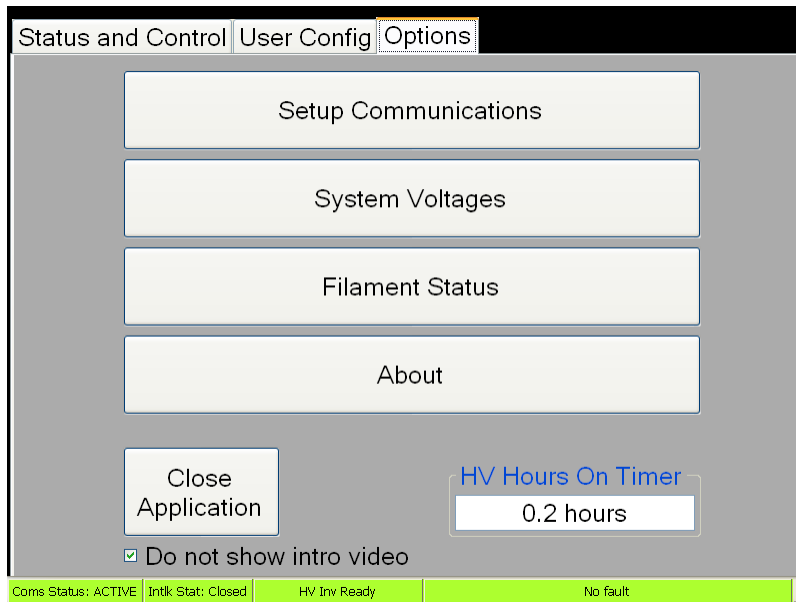
Please type in a kV value for step 1 using the on-screen keypad.

	kV	mA	Time (min)
	80	18.7	2
	120	18.7	2
	140	18.7	2
	150	18.7	2
▶	160	18.7	2

Save seasoning profile: enter name and press enter to save.

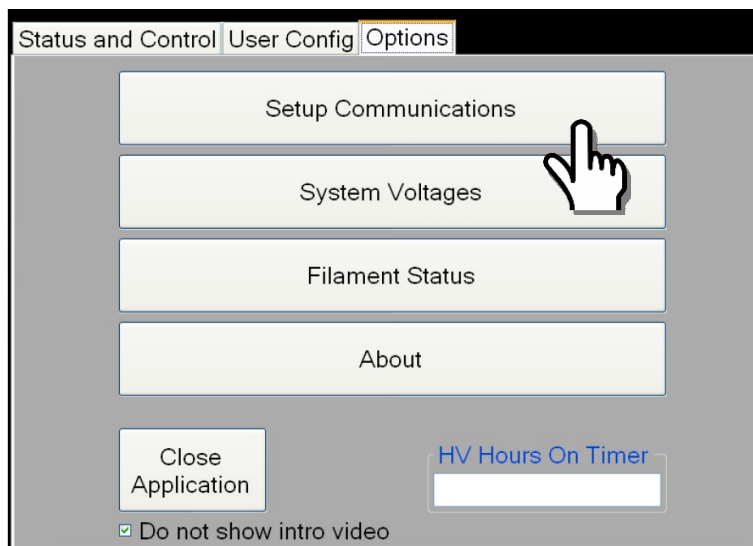


Options: support and status screen, setup communication, monitor system voltages, filament control and System information.

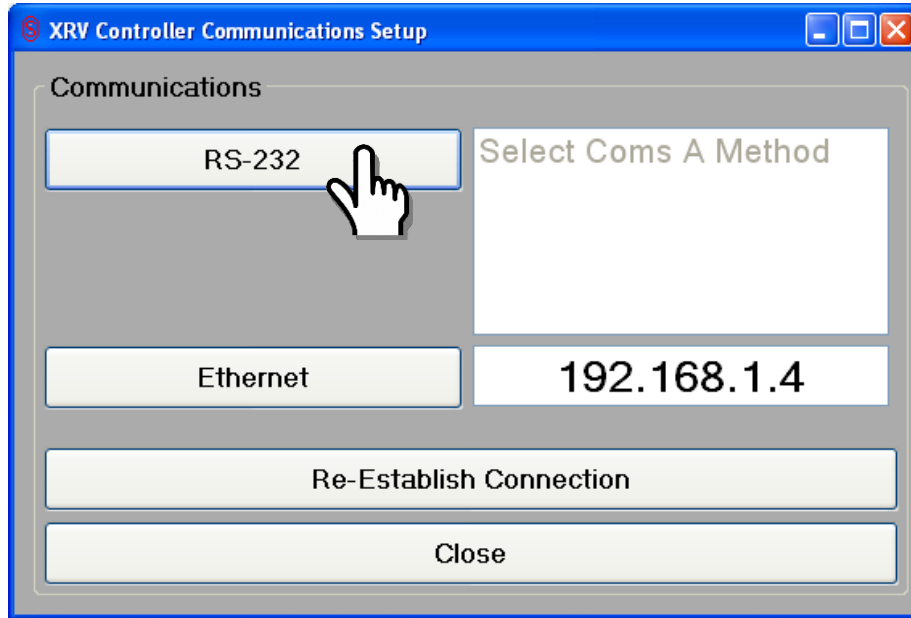


Setup Communication: to establish or change communication.

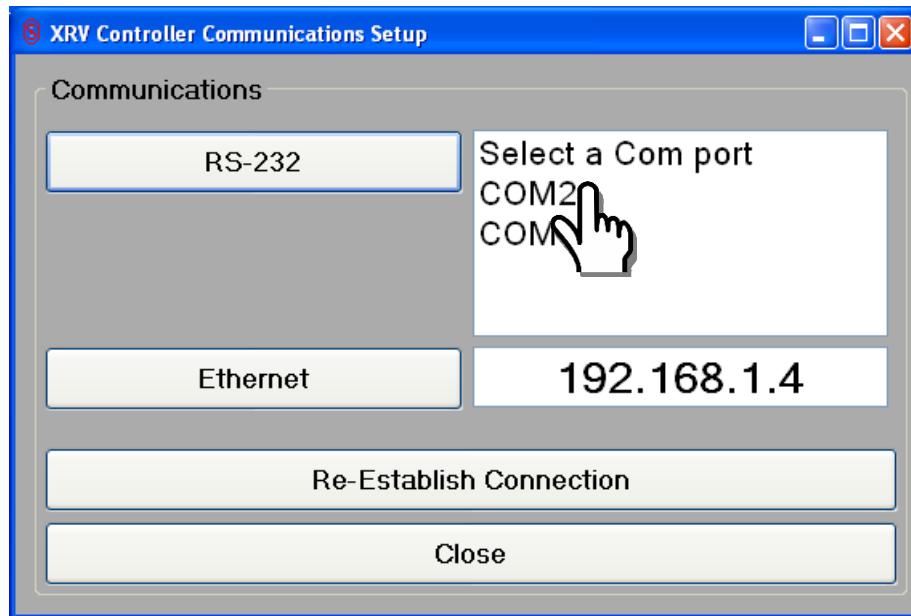
This screen will allow the user to select communication with the XRV high voltage power supplies. The choices are Ethernet or serial RS-232(default)



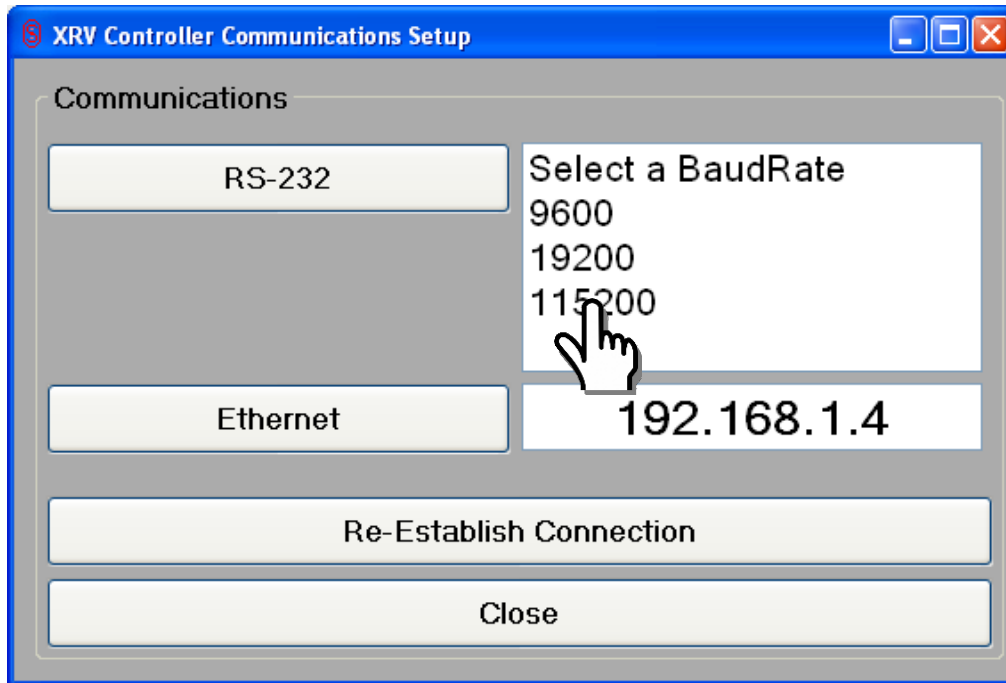
RS-232: Select the appropriate com port, baud rate, Data bits, Parity and Stop Bits. Then “Click here to save these setting”



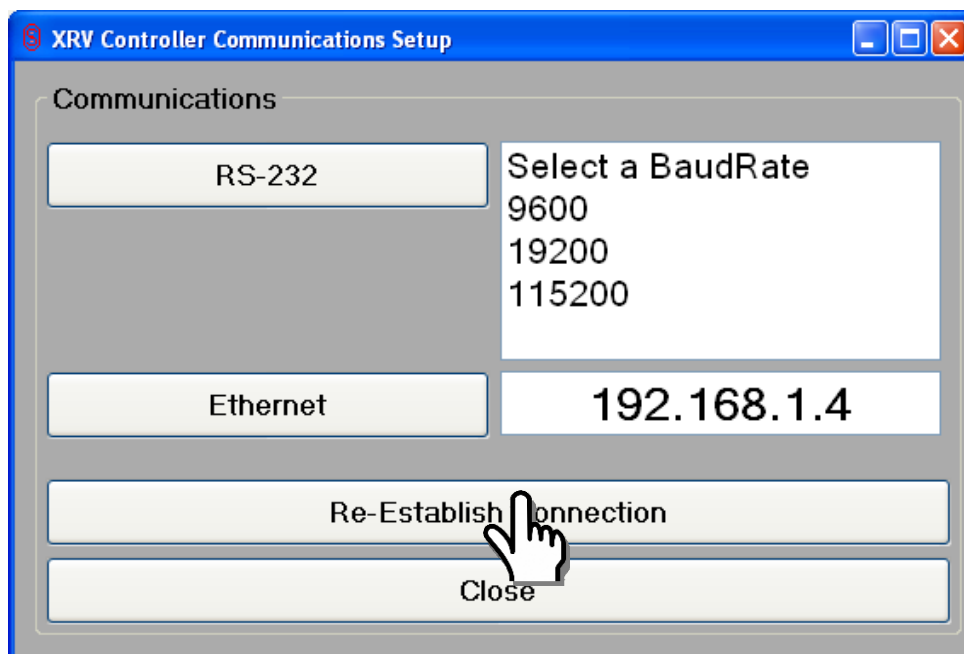
Select COM 2



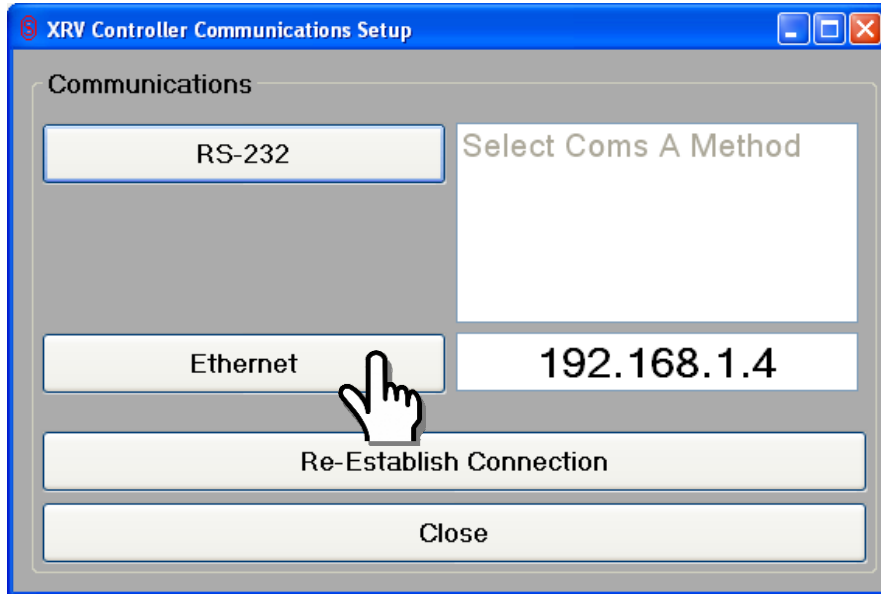
Select baud rate



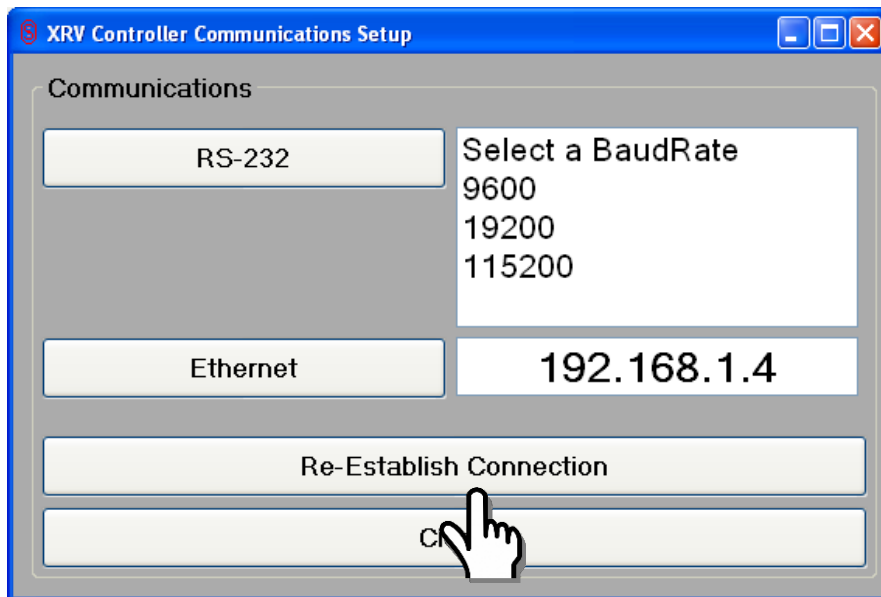
Press "Re-Establish Connection" and "Close" to save these setting.



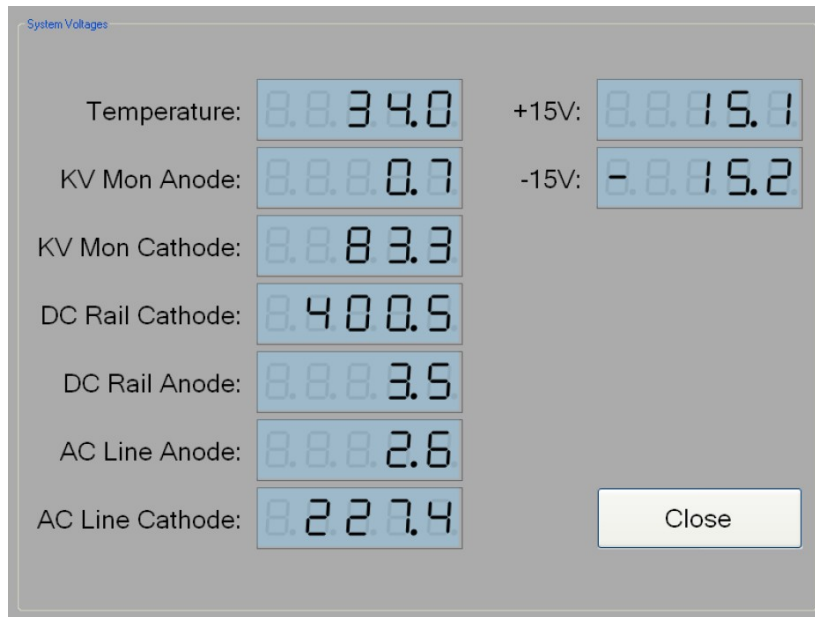
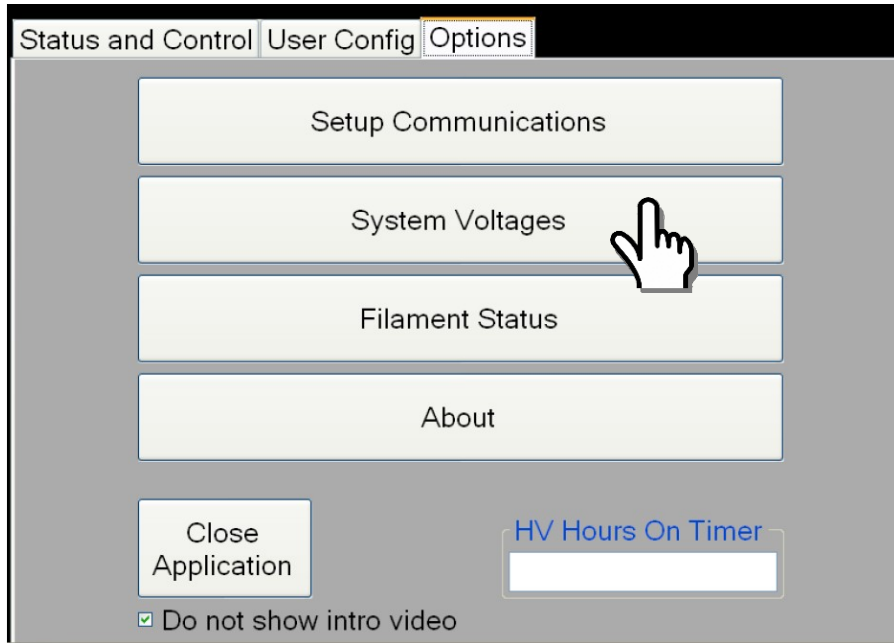
Ethernet: Click on box “Ethernet Communications” verify IP address and press “Close” to save these setting.



Press “Re-Establish Connection” and “Close” to save these setting.



System Voltages: monitor various voltages and Temperature on the unit.



Displayed Information:

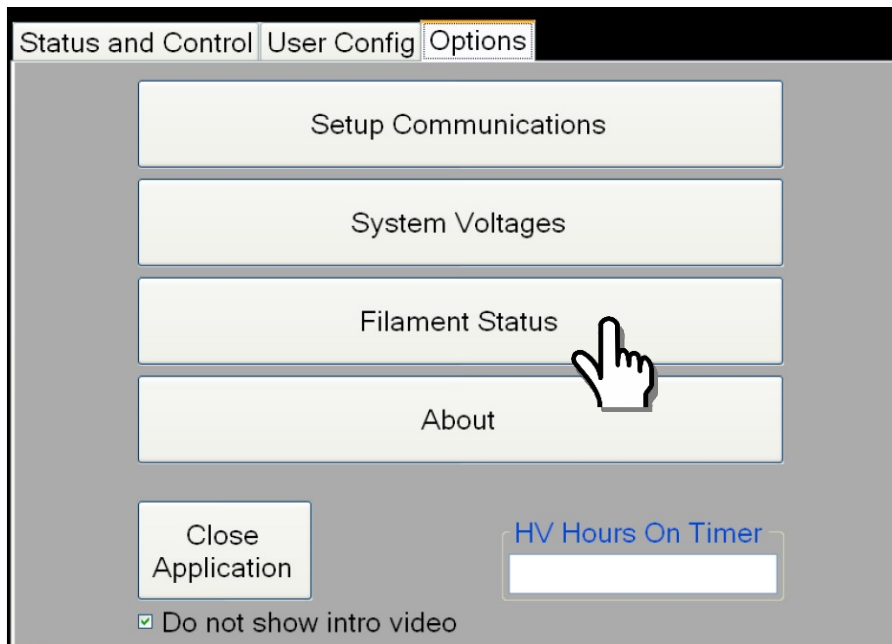
System Voltages: This indicates the +15V/-15V voltage supply on the system control board.

Misc. Cathode readings: Valid for Bipolar or Uni-polar units, indicates Cathode HV output, Cathode inverter AC input voltage and inverter DC Rail voltage.

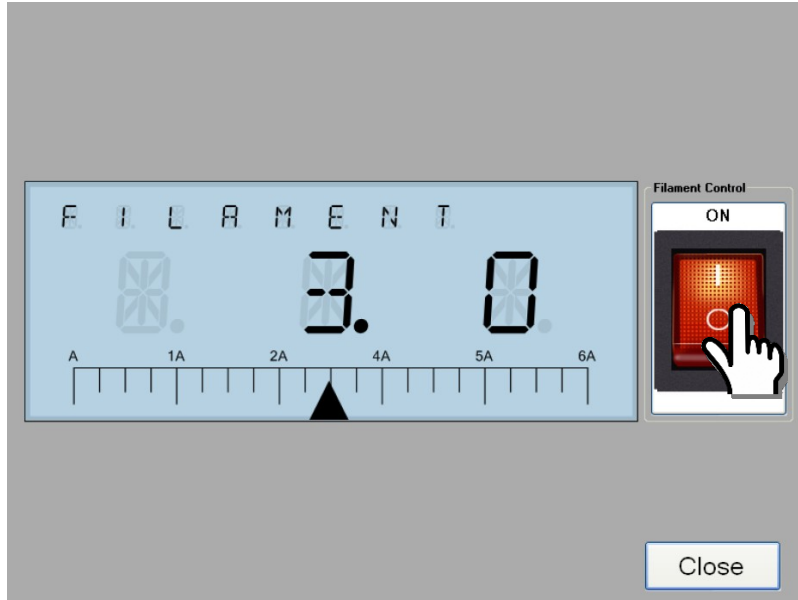
Misc. Anode reading: Valid for Bipolar unit, indicates Anode HV output, anode inverter AC input voltage and inverter DC Rail Voltage.

Temperature: Indicates the measured internal temperature of the HVPS.

Filament Status

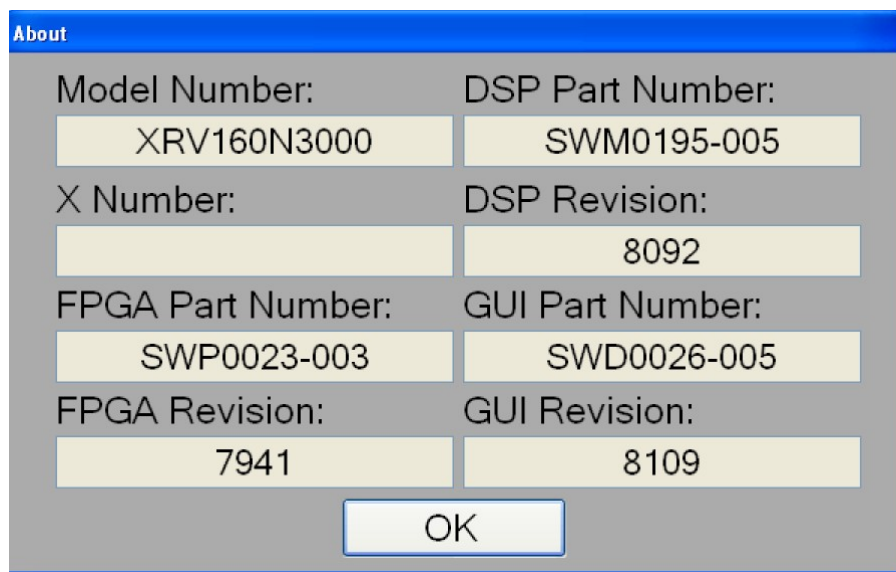


Filament Control: numeric box indicating actual filament current, with HV off it will equal the preheat current and with HV ON, (in ECR) it will equal filament current to deliver request mA value. The switch will turn filament ON or OFF.



About:

System information, Firmware Information: Indicates DSP and FPGA part number and version number.



User config access



Only persons who are properly trained are allowed access.

Configuration password

Please enter the user config code

useraccess

q	w	e	r	t	y	u	i	o	p
a	s	d	f	g	h	j	k	l	
Clear	z	x	c	v	b	n	m	Enter	
Cancel	SPACE							Numbers	

Status and Control | **User Config** | Options

KV Over Voltage 87%	Arc Count 1	Power Limit Large 3000W Small 600W
X-ray Prewarning 1 Sec	Quench Time 0.05S	Filament Limit Large 4.2A Small 4.1A
KV Ramp Rate 5.0Sec	Max KV 160.0KV	Preheat Limit Large 1.5A Small 1.5A
mA Ramp Rate 4.0Sec	Max mA 30.0mA	
Watch Dog Timer 9S	<input checked="" type="checkbox"/> mA KV Rollback	

Selected Tube Profile

(no tube selected)

Coms Status: ACTIVE | Intlk Stat: Closed | HV Inv Ready | No fault

User Parameters

KV over voltage: Over Voltage Fault will occur at this setting. This percentage is related to a full-scale reading of analog converter on the system control board. The default setting for all units is 87%; this value should not be changed without consulting the factory.

XRV160	100% = 192kV, 87% = 167kV
XRV225	100% = 270kV, 87% = 234kV
XRV320	100% = 384kV, 87% = 334kV
XRV450	100% = 540kV, 87% = 469kV

X-ray Pre-warning: delay time from X-ray ON and the actual turn on of HV. The Pre-warning indicator will be on during this time. The time values are in seconds.

KV ramp rate: time in seconds for the kV high voltage output to go from 0 to FS rated output voltage.

mA ramp rate: time in seconds for the mA output current to go from 0 to FS rated output current.

Arc Count: number of arcs before arc fault is issue and HV is turned off.

Quench time: time that HV is held off after an arc has been detected, applies only when Arc Counter > 1

Max kV: maximum kV setting for the unit must be less or equal the high voltage power supply output voltage ratings for kV.

Max mA: maximum mA setting for the unit must be less or equal the high voltage power supply output current ratings for mA.

Filament Parameters

Large Power Limit: This is maximum power that can be set (product of kV multiplied mA) when Large Filament is selected. Over power fault will occur if actual power exceeds 5% above this set value. This value is stored in HVPS memory.

Small Power Limit: This is maximum power that can be set (product of kV multiplied mA) when small Filament is selected. Over power fault will occur if actual power exceeds 5% above this set value. This value is stored in HVPS memory.

Large Filament Limit: Maximum Current the HVPS will produce before it goes into current limit mode. This value must be less than or equal to 6 Amperes.

Small Filament Limit: Maximum Current the HVPS will produce before it it goes into current limit mode. This value must be less than or equal to 6 Amperes.

Preheat Filament Large: Filament current during standby mode with HV off, typical set value = Large Filament Large/2.

Preheat Filament Small: Filament current during standby mode with HV off, typical set value = Small Filament Small/2.

User Options:

Parameter/Function	Range	Default	Notes
Large Filament Power Limit XRV160,225 XRV320,450	0-3000 Watts 0-4500 watts	3000 watts 4500 watts	See tube data
Small Power Limit XRV160,225 XRV320,450	0-3000 Watts 0-4500 watts	3000Watts 4500 watts	See tube data
Max kV XRV160 XRV225 XRV320 XRV450	0-160kV 0-225kV 0-320kV 0-450kV	160kV 225kV 320KV 450kV	
Max mA	0-30 ma	30ma	
Filament Current Limit Large	0-6 Amps	4 Amps	Cal. Current with actual load
Filament Current Limit Small	0-6 Amps	4 Amps	Cal. Current with actual load
Filament Preheat Current Large	0-6 Amps	2 Amps	Typical value: Current Limit Large/2
Filament Preheat Current Small	0-6 Amps	2 Amps	Typical value: Current Limit Small/2
Arc Trip Counter	0-30	1	
Arc Quench Time	10msec-1sec	50 sec	Counter will reset in 100X set value (100sec max.)
kV Slew Time	100 msec-30sec	5 sec	Typical 5 sec
mA Slew Time	100 msec-30sec	5 sec	Typical 5 sec
Pre-warn Time	0-30sec	1 sec	Warning before HV ON (X-Ray ON)

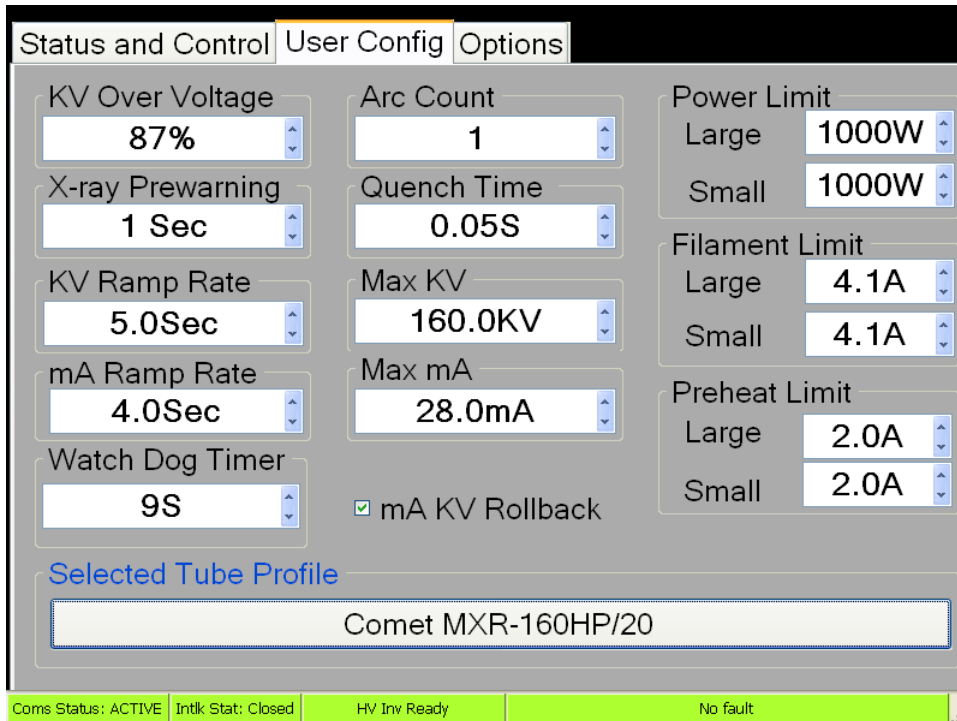
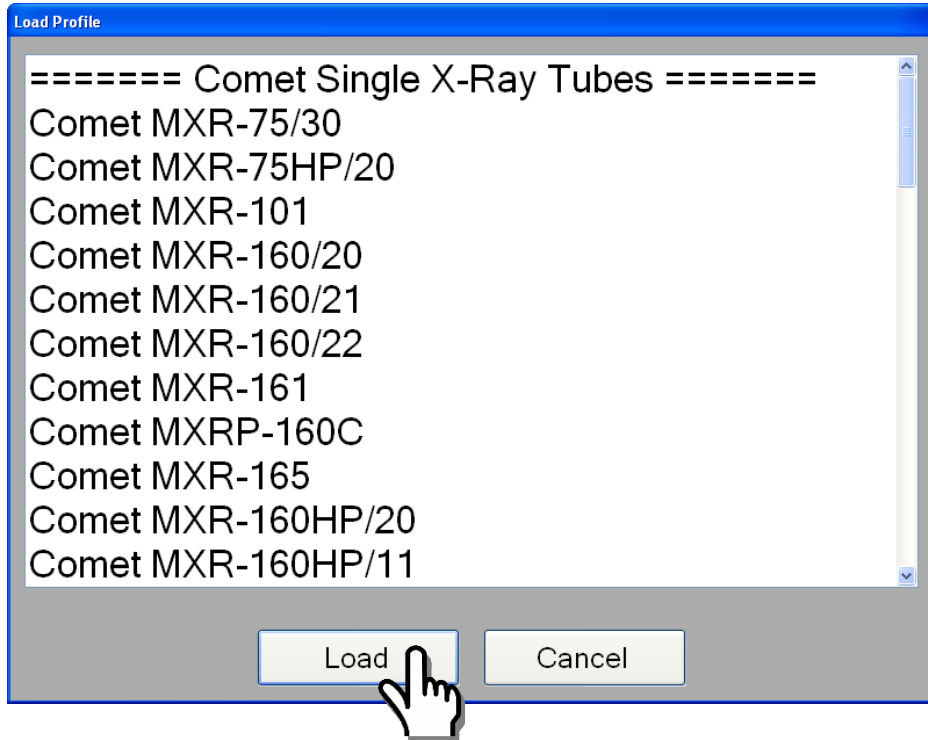
Loading X-ray tube data into User Config, press “Select Tube Profile”

The screenshot displays the 'User Config' tab of the control interface. It features several adjustable parameters, each with a numerical value and up/down arrows for adjustment:

- KV Over Voltage:** 87%
- X-ray Prewarning:** 1 Sec
- KV Ramp Rate:** 5.0Sec
- mA Ramp Rate:** 4.0Sec
- Watch Dog Timer:** 9S
- Arc Count:** 1
- Quench Time:** 0.05S
- Max KV:** 160.0KV
- Max mA:** 30.0mA
- mA KV Rollback:**
- Power Limit:** Large (3000W), Small (600W)
- Filament Limit:** Large (4.2A), Small (4.1A)
- Preheat Limit:** Large (1.5A), Small (1.5A)

At the bottom, the 'Selected Tube Profile' dropdown menu is highlighted with a hand cursor, showing the text '(no tube selected)'. The status bar at the very bottom indicates: 'Coms Status: ACTIVE', 'Intlk Stat: Closed', 'HV Inv Ready', and 'No fault'.

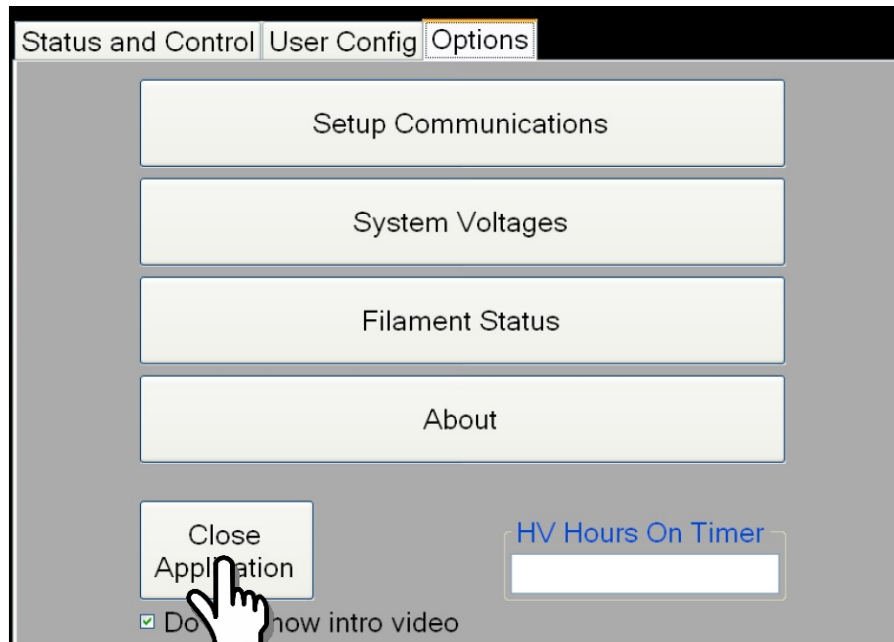
Select tube from list and press load



System Shutdown

The windows base application software must closed properly before tuning the key to off position.

1. Turn Key Switch to the STANDBY position the system is in standby, cooler is enabled and aux power to HVPS is ON. No X-rays can be generated in this position (main contractor is OFF).
2. Turning the Key switch to the OFF position will shut down the application and start the tube cool down cycle.



1. Turn Key Switch to position 1: system is OFF and the key can be removed from switch housing, if system is supplied with XRV I/O box cooler will remain on for 15 min. Don't turn off Circuit Breaker or Main Power! Do not restart the system until the cool down cycle has completed and the cooler shut down.